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Migration of Steppe Eagles *Aquila nipalensis* and other raptors along the Himalayas past Dharamsala, India, in autumn 2001 and spring 2002

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The number of Steppe Eagles *Aquila nipalensis* and other raptors migrating along the Himalayas was counted in Dharamsala, Himachal Pradesh, India, during autumn 2001 and spring 2002. A total of 8,194 Steppe Eagles was counted passing north-west during autumn 2001, and a total of 10,000-11,000 individuals was extrapolated. In spring 2002, 5,204 individuals were counted, and a total of 5,900-6,600 was estimated. In autumn, eagles were seen migrating throughout the day from 09h30 to 17h00. By contrast, in spring, eagles were seen almost exclusively between 09h00 and 11h30 and between 16h00 and 18h00. A total of 33 raptor species were identified, including small numbers of Greater Spotted Eagle *A. clanga* and Imperial Eagle *A. heliaca*, but many more individuals of these two species were probably overlooked.

INTRODUCTION

The Steppe Eagle *Aquila nipalensis* has a global population in the range of 100,000–1,000,000 individuals. It breeds in extreme south-eastern Europe, across central Asia, south-west Russia, east through the Kirghiz steppes and northern Kazakhstan to Transbaikalia and west Manchuria, south to the Aral sea, Tien Shan, northern Tibet and Mongolia. It winters in eastern Africa, and to a lesser extent southern Africa, with fewer also in the Middle East, and in south Asia from Afghanistan and the Indian subcontinent east to Myanmar. The breeding populations move south from about October, on fairly broad fronts. Western populations pass both north and south of the Caspian Sea, with main concentrations crossing into Africa at either end of the Red Sea after having flown through Israel and Suez or straight across Arabia to Yemen. Individuals wintering in Africa return from January–February. Movements of the eastern populations are not well known, but some almost certainly winter with western populations in north-east Africa (Ferguson-Lees and Christie 2001).

The migration of *Aquila* spp. eagles along the Himalayas was first referred to by Donald (1923), who noted a regular migration of eagles (identified as juvenile Imperial Eagle *Aquila heliaca*, but probably referring to Steppe Eagle). Fleming (1983) estimated that possibly 45,000 eagles migrated west through Nepal in autumn. The only published systematic count was by de Roder (1989), who estimated that 10,000–20,000 Steppe Eagles pass through Nepal each autumn. Not all Steppe Eagles from the eastern populations cross the Himalayas in autumn: an adult female fitted with a satellite transmitter in south-east Mongolia in 1995 wintered in south-east Tibet (Ellis *et al.* 2001).

Dharamsala is located in Kangra district, Himachal Pradesh, India, at 32°22′N 76°32′E, at an altitude of 1,500 m. The Dhauladhar mountain range runs south-east to north-west in the area, with peaks at 4,200–4,600 m (Fig. 1). The highest major settlement in the area is McLeod Ganj, at 32°25′N 76°32′E and 1,900 m. *Aquila* spp. eagles migrate through this area mainly at 1,500–2,800 m, occasionally higher. They approximately follow the direction of the Dhauladhar

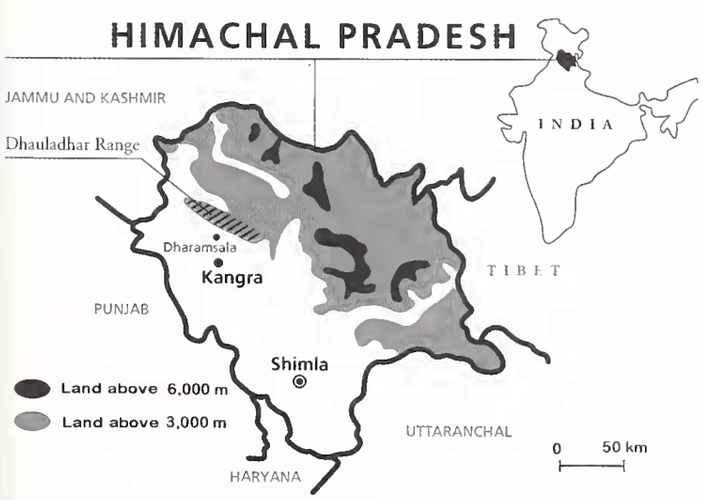

Figure 1. Map showing the location of the Dhauladhar range in India.

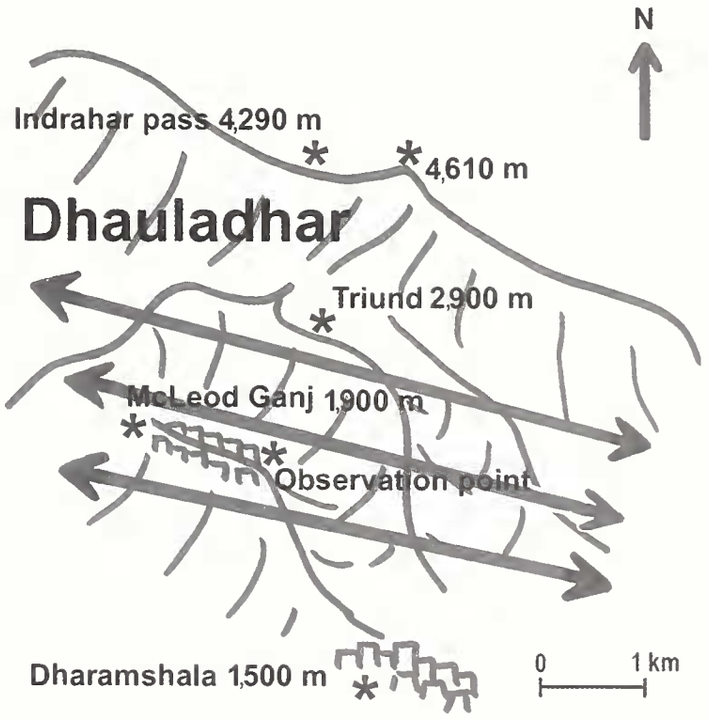

Figure 2. Approximate position of the main pathways of migrating *Aquila* eagles in relation to the Dhauladhar range, the observation point at McLeod Ganj village and Dharamsala main town.

range, but seem to take a slightly more westerly direction in autumn (Fig. 2).

I carried out *ad hoc* counts of up to 450 eagles during spring and autumn migration from 1998 to 2001 in Dharamsala, India. Here I report on the results of more systematic counts carried out in 2001–2002.

METHODS

Observations at viewing points from 1,500 m to 2,400 m showed that positions further away from the main range and at a lower elevation gave more favourable lighting conditions because the eagles passed against a less hazy background. Such sites were also found to be better because migration pathways shifted to lower altitudes and greater distances from the main range when clouds built up in the afternoon. I therefore carried out the systematic counts from a roof-top in McLeod Ganj at 1,900 m.

Eagles were located and counted using 8x25 binoculars, and photographed with a Canon EOS 50E camera and a Sigma 170-500 mm *f*1:5–6.3 lens. Counts were divided into 15-minute blocks. Numbers, and where possible, age, were noted. In autumn 2001, out of the 38-day migration period between 23 October and 30 November I carried out full counts on 20 days and partial counts on four days. On one of the uncounted days migration did not take place due to bad weather. In spring 2002, out of the 40-day main migration period between 19 February and 29 March I counted 29 days fully, with the exception of periods with bad weather. Parts of days when migration was very low were not counted or were sampled by counting one in three or four 15-minute blocks. Out of a total of 1,482 15-minute blocks falling within the main migration period, 178 lacked migration because of bad weather. Of the remaining time, I counted 762 15-minute blocks, representing 58% of all migration time. The uncounted time included several afternoons at the beginning of the migration period during which I might have missed some migration peaks. Further into the migration period, sequences of uncounted 15-minute blocks normally did not exceed three blocks in a stretch, ruling out the possibility of missing major peaks of movement. Because migration continued at a low intensity through most of April, I carried out sampled counts until 18 April.

IDENTIFICATION

Due to the height and speed of most of the migrating eagles, only a small proportion could be scrutinised in detail and/or photographed. The vast majority of such individuals were identified as Steppe Eagle. Photographs and descriptions of possible Greater Spotted Eagle *Aquila clanga* and Imperial Eagle were discussed with W. S. Clark to determine identification. It is likely that several or many individuals of these two species were overlooked amongst the Steppe Eagles. Occurrence of the recently split Indian Spotted Eagle *A. hastata* (Parry *et al.* 2002) was not conclusively established. The highest migrating eagles were potentially confusable with *Gyps* spp. vultures, but were distinguished by wing shape and posture, less bulky appearance and less leisurely flight.

RESULTS

Table 1 gives maximum daily counts and seasonal totals for raptor species counted during the survey. The survey period covered about 65% of the 2001 autumn migration period and about 58% of the main 2002 spring migration of the Steppe Eagle. Because of the focus on *Aquila* spp. eagles, other species were

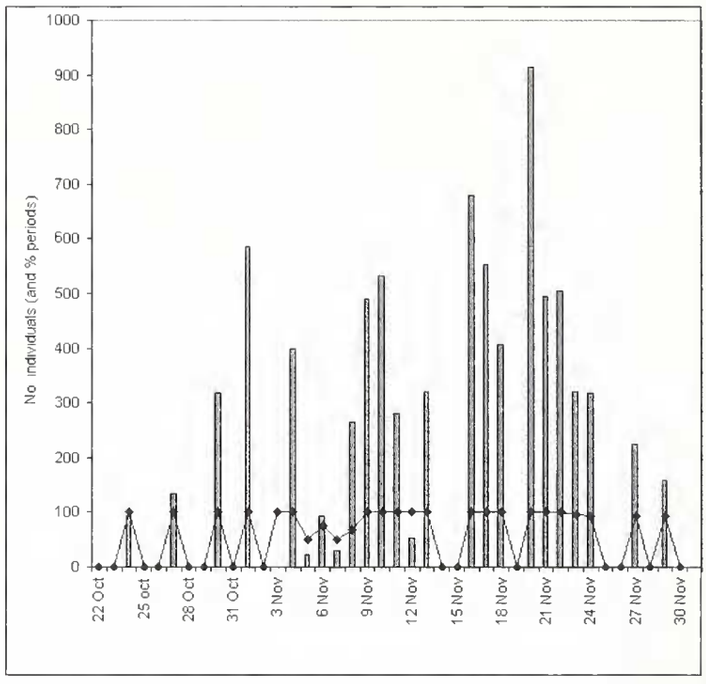

Figure 3. Daily totals of migrating Steppe Eagles during the 38 days of the main migration period in autumn 2001 (bars), with the percentage of 15-minute periods counted on each day (line).

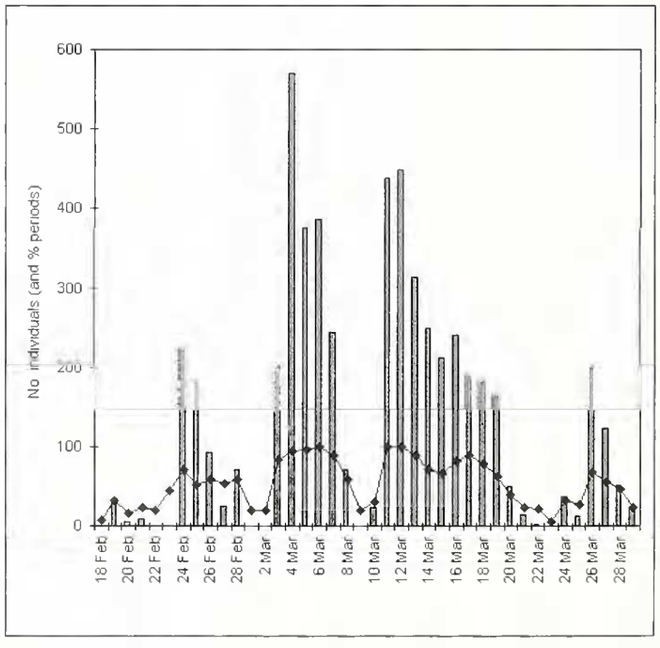

Figure 4. Daily totals of migrating Steppe Eagles during the 40 days of the main migration period in spring 2002 (bars), with the percentage of 15-minute periods counted on each day (line).

Table 1. Maximum daily counts and seasonal totals for raptors at McLeod Ganj during autumn 2001 and spring 2002.

Species	Migrating max. daily count		Migrating total		Non-migrating max. daily count[1]	
	autumn	spring	autumn	spring	autumn	spring
Oriental Honey-buzzard *Pernis ptilorhyncus*	1	1	1	4		
Black Kite *Milvus migrans*	0	29	0	80	12	14
Lammergeier *Gypaetus barbatus*					2	3
Egyptian Vulture *Neophron percnopterus*					12	18
White-rumped Vulture *Gyps bengalensis*					2	13
Himalayan Griffon *Gyps himalayensis*					88	40
Eurasian Griffon *Gyps fulvus*					0	1
Cinereous Vulture *Aegypius monachus*					4	2
Red-headed Vulture *Sarcogyps calvus*					1	1
Short-toed Snake Eagle *Circaetus gallicus*					1	1
Crested Serpent Eagle *Spilornis minimus*					2	2
Eurasian Marsh Harrier *Circus aeruginosus*	0	1	0	1		
Hen Harrier *Circus cyaneus*	1	1	2	3		
Pallid Harrier *Circus macrourus*	0	1	0	1		
Shikra *Accipiter badius*	0	1	0	1		
Eurasian Sparrowhawk *Accipiter nisus*	4	5	11	35	1	1
Northern Goshawk *Accipiter gentilis*	1	1	1	4	2	0
White-eyed Buzzard *Butastur teesa*					0	1
Common Buzzard *Buteo buteo*	1	1	1	2		
Long-legged Buzzard *Buteo rufinus*	1	29	1	180	0	1
Upland Buzzard *Buteo hemilasius*	0	1	0	1		
Buzzard spp. *Buteo* spp.	0	5	0	13		
Black Eagle *Ictinaetus malayensis*					0	2
Greater Spotted Eagle *Aquila clanga*	4	6	11	15	3	2
Tawny Eagle *Aquila rapax*					2?	0
Steppe Eagle *Aqiula nipalensis*	914	570	8,194	5,204	4	12
Imperial Eagle *Aquila heliaca*	1	1	2	1	1	0
Golden Eagle *Aquila chrysaetos*					2	2
Bonelli's Eagle *Hieraaetus fasciatus*					0	1
Booted Eagle *Hieraaetus pennatus*	1	2	3	9	3	3
Mountain Hawk Eagle *Spizaetus nipalensis*					0	1
Common Kestrel *Falco tinnunculus*	1	12	1	64	1	1
Eurasian Hobby *Falco subbuteo*					0	2
Peregrine Falcon *Falco peregrinus*					2	4

[1]The last two columns give combined figures for resident species, estimated numbers of resident individuals of migratory species, and non-migratory species that were rarely observed.

surveyed less completely. For example, migration of Booted Eagle *Hieraaetus pennatus*, Oriental Honey-buzzard *Pernis ptilorhyncus* and Black Kite *Milvus migrans* peaks later in spring, and migration of Common Buzzard *Buteo buteo*, Common Kestrel *Falco tinnunculus* and Eurasian Sparrowhawk *Accipiter nisus* continues later than the period of counts.

Steppe Eagle migration

A total of 8,194 Steppe Eagles was counted during the 2001 autumn migration (Fig. 3). The highest daily total was 914 on 20 November, with a peak of 194 per hour at 13h30 to 14h30. Counts of 100–150 per hour were made on several days. Of the 11 days on which counts were not made, only five occurred during the height of migration. No counts were undertaken after 30 November. On 2 December, there still appeared to be some movement, but this may have simply referred to the c.6 Steppe Eagles that wintered in the area. By considering migration intensity and weather conditions on uncounted days and the preceding and following counted days, the numbers can be extrapolated to give a total estimate of 10,000–11,000 Steppe Eagles migrating through the area.

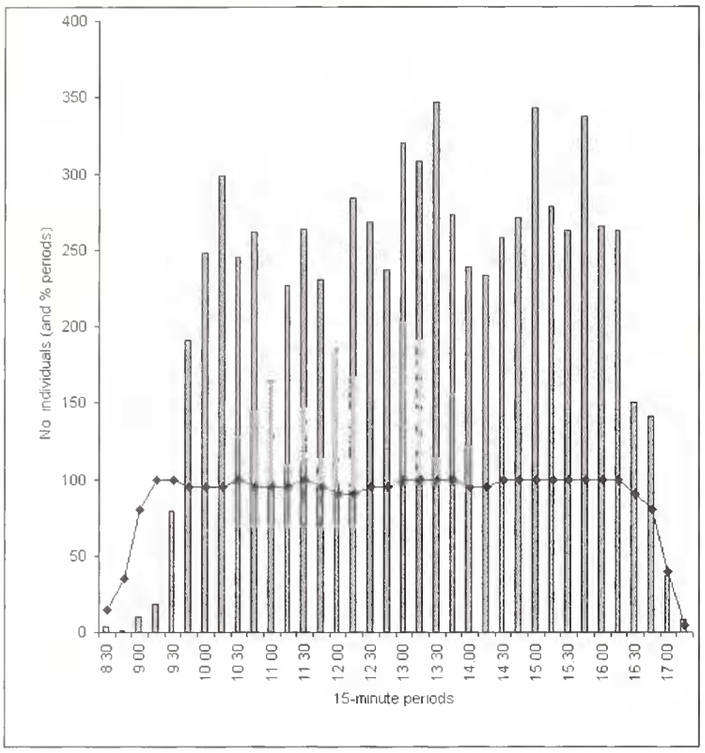

Figure 5. Total number of Steppe Eagles counted per 15 minutes for the 20 fully counted days during autumn 2001 (bars), with the percentage of periods counted (line).

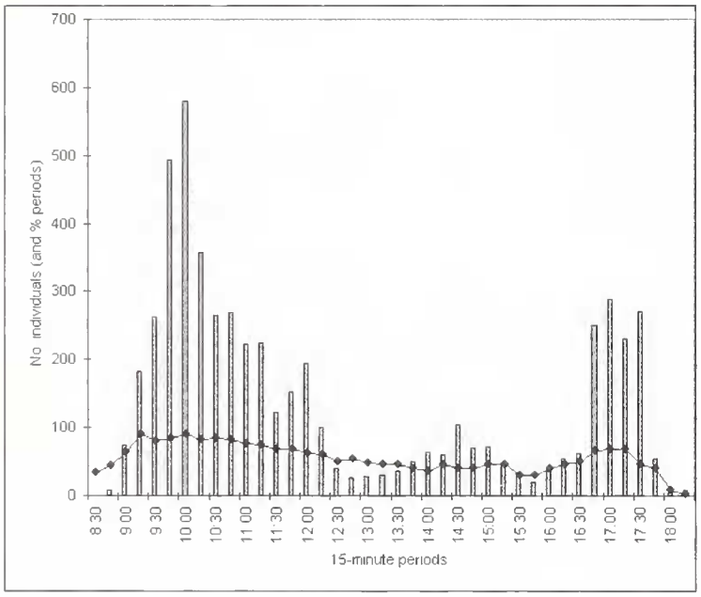

Figure 6. Total number of Steppe Eagles counted per 15 minutes for the 40 days of the main spring migration period in 2002 (bars), with the percentage of periods counted (line).

A total of 5,204 eagles was counted during the 40 days of the main spring migration in 2002 (Fig. 4). Migration peaked on 4 March, when 570 eagles were counted, with 263 passing between 09h30 and 10h30. Migration in April mainly involved immature birds, with two or three passing through even as late as 22 April. The total counts can be extrapolated to give an estimate of 5,900–6,600 through the whole spring migration period.

In autumn, eagles were seen migrating throughout the day from 09h30 to 17h00 (Fig. 5). By contrast, in spring, eagles were seen almost exclusively between 09h00 and 11h30 and between 16h00 and 18h00 (Fig. 6). Sunrise and sunset were at 06h07 and 17h13 on 26 October compared to 05h48 and 18h14 on 29 March, so the start and end of migration each day was broadly similar in spring and autumn. Birds began passing 2–3 hours after sunrise, and at the end of the day they continued until up to 30 minutes after sunset.

As expected, migration was influenced by weather. The passage of a weak front, with some rain and wind in its wake, led to sudden surges in the numbers of individuals migrating. The maximum passage of 294 Steppe Eagles in 45 minutes on 10 March 1999 occurred following a weak front that had produced some drizzle. Similarly, on 24 February 2002, early in the migration period, 114 eagles passed in one hour, as individuals moved out of the area prior to a rain shower that started at 15h00. More extensive fronts caused greater disruption. For example, on 3 November 2001 a weather front approaching from the west produced strong winds and some rain and caused all movement to halt. Unstable conditions over the following four days led to low numbers of individuals migrating, and numbers did not pick up again until 8 November, when conditions improved. Similarly in spring 2002, several periods of cloudy and showery weather for 2–3 days each showed clearly lower numbers of individuals.

DISCUSSION

Large numbers of Steppe Eagles migrated north-west through the area of Dharamsala in autumn 2001 (10,000–11,000 individuals estimated), and returning south-east in spring 2002 (5,900–6,600 individuals estimated). The totals suggest that at least 10,000 individuals winter somewhere west of India. The numbers accord well with those of de Roder (1989) who counted 8,794 Steppe Eagles in 18 days in central Nepal and estimated the total number migrating through Nepal to be 10,000–20,000. This estimate seems more reliable than Fleming's (1983) estimate of 45,000 individuals, which was extrapolated from partial counts on just a few days. It follows that c.50–100% of Steppe Eagles migrating through Nepal continue beyond the north-west end of the Himalayas in India and winter not in south Asia but further west. Tens of thousands of Steppe Eagles winter in Africa, entering the continent through bottlenecks such as Eilat, Israel (Christensen and Sorensen 1989, Welch and Welch 1991).

About 40% fewer individuals were detected during the spring than during autumn. This would appear to be too large a difference in numbers to be explained by winter mortality alone. Discrepancies between spring and autumn migration of Steppe Eagles have also been described for migration bottlenecks such as Eilat, Suez and Bab-el-Mandeb at the south-western tip of the Arabian Peninsula (Yom-Tov 1984, 1988). A recent study using satellite telemetry showed that migrating Steppe Eagles wintering in southern Africa make a large detour around the Red Sea in spring migration, probably because the prevailing easterly winds between October and April make return migration via Bab-el-Mandeb more difficult (Meyburg *et al.* 2003). A similar phenomenon may cause the difference between the numbers of Steppe Eagles migrating along the

Himalayas in spring and autumn, with some individuals taking a more northerly route in spring to fly more directly towards breeding grounds in areas such as Mongolia.

While the migration direction of Steppe Eagle, Greater Spotted Eagle and Imperial Eagle over Dharamsala was mainly north-west to west-north-west in autumn and south-east to east-south-east in spring, the migration direction of all other raptors was more or less opposite to this. This is because most other raptors passing over Dharamsala in autumn originate from breeding grounds in Central Asia. They migrate south-east in autumn and cross the western Himalayas to reach their wintering grounds in the Indian subcontinent. By contrast, the *Aquila* eagles from eastern populations cross the Himalayas somewhere east of central Nepal and then move westward along the Himalayas to wintering areas west of the Indian subcontinent. Because of the curve of the Himalayas they travel almost north-west by the time they have reached the western end of the Himalayas.

It is clear that more research is needed in order to find out exactly where the Steppe Eagles that migrate along the Himalayas winter, and the routes they take to return in spring. It would also be interesting to find out more precisely the numbers of Greater Spotted and Imperial Eagles that are involved: they are likely to be larger than the numbers described here.

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